CBCS SCHEME

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18MAT41

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Complex Analysis, Probability and Statistical Methods

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. State and prove Cauchy – Riemann equations in Cartesian form. **(07 Marks)**

b. Find the analytic function f(z) = u + iv, given that $u - v = e^x[\cos y - \sin y]$. **(07 Marks)**

c. If y(z) is an analytic function, then show that :

$$\left\{\frac{\partial}{\partial x}|f(z)|\right\}^2 + \left\{\frac{\partial}{\partial y}|f(z)|\right\}^2 = |f'(z)|^2.$$ **(06 Marks)**

OR

2 a. Determine the analytic function f(z), where imaginary part is $\left(\gamma - \frac{K^2}{\gamma}\right)\sin\theta$, $r \neq 0$. Hence find the real part 07 f(z). **(07 Marks)**

b. Find the analytic function f(z), whose real part is $u = \log\sqrt{x^2 + y^2}$. **(07 Marks)**

c. Show that $f(z) = z^n$ is analytic and hence find its derivative. **(06 Marks)**

Module-2

3 a. Discuss the transformation $w = z^2$. **(07 Marks)**

b. State and prove Cauchy's integral theorem. **(07 Marks)**

c. Evaluate : $\int_0^{(2+i)} (\bar{z})^2 dz$, along the real axis up to 2 and then vertically to 2 + i. **(06 Marks)**

OR

4 a. Evaluate : $\int_c \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)(z-2)} dz$ where c is the circle $|2| = 3$. **(07 Marks)**

b. Find the bilinear transformation that maps the points z = 1, i, –1 onto w = 0, 1, ∞. **(07 Marks)**

c. Evaluate : $\int_{(1-i)}^{(2+i)} (2x + iy + 1)\, dz$ along the straight line joining the points (1, –1) and (2, 1). **(06 Marks)**

Module-3

5 a. A coin is tossed twice. If x represents the number of heads turning up, find the probability distribution of x. also find its mean and variance. **(07 Marks)**

b. If 2% of the fuses manufactured by a firm are defective. Find the probability that a box containing 200 fuses contains : i) no defective fuses ii) 3 or more defective fuses. **(07 Marks)**

c. In a normal distribution, 31% of the items are below 45 and 8% of the items are above 64. Find the mean and standard deviation of the distribution. Given that : A(1.4) = 0.42 and A(0.5) = 0.1915. **(06 Marks)**

OR

6 a. Find the constant K such that

$$f(x) = \begin{cases} Kx^2; & -3 \le x \le 3 \\ o; & \text{otherwise} \end{cases}$$

is a probability density function. Also find :

i) $P(1 \le x \le 2)$

ii) $P(x \le 2)$

iii) $P(x > 1)$. **(07 Marks)**

b. When a coin is tossed 4 items, find the probability of getting

i) exactly one head

ii) at most 3 heads

iii) at least 2 heads. **(07 Marks)**

c. If x is an exponential variate with mean 5. Evaluate :

i) $P(0 < x <)$

ii) $P(-\infty < x < 10)$

iii) $P(x \le 0)$ or $(x \ge 1)$. **(06 Marks)**

Module-4

7 a. Find the coefficient of correlation and the lines of regression for the following data :

x	1	2	3	4	5
y	2	5	3	8	7

(07 Marks)

b. Fit a curve of the form $y = ax^b$ for the data :

x	1	2	3	4	5
y	0.5	2	4.5	8	12.5

(07 Marks)

c. If the equations of regression lines of two variables x and y are $x = 19.13 - 0.879$ and $y = 11.64 - 0.5x$. Find the correlation coefficient and the means of x and y. **(06 Marks)**

OR

8 a. Compute the rank correlation coefficient for the following data :

x	68	64	75	50	64	80	75	40	55	64
y	62	58	68	45	81	60	68	48	50	70

(07 Marks)

b. Fit a parabola $y = a + bx + cx^2$ by the method of least squares to the following data :

x	1	2	3	4	5	6	7
y	2.3	5.2	9.7	16.5	29.4	35.5	54.4

(07 Marks)

c. Compute the mean values of x and y and the coefficient correlation for the regression lines $2x + 3y + 1 = 0$ and $x + 6y - 4 = 0$. **(06 Marks)**

Module-5

9 a. The joint probability distribution of two random variables x and y is defined by the function $P(x, y) = \frac{1}{27}(2x + y)$, where x and y assume the values 0, 1, 2. Find the marginal distributions of x and y. Also compute E(x) and E(y). **(07 Marks)**

b. Fit a Poisson distribution for the following data and test the goodness of fit. Given that $\Psi^2_{0.05} = 9.49$ for degrees of freedom 4. **(07 Marks)**

c. Write short notes on :
i) Null hypothesis
ii) Type – I and Type – II
iii) Level of significance. **(06 Marks)**

OR

10 a. Joint probability distribution of two random variables is given by the following data :

x \ y	–3	2	4
1	0.1	0.2	0.2
3	0.3	0.1	0.1

Find :
i) Marginal distributions of x and y
ii) Cov(x, y)
iii) P(x, y). **(07 Marks)**

b. The following are the I·Q's of a randomly chosen sample of 10 boys.
70, 120, 110, 101, 88, 83, 95, 98, 107, 100
Does this data support the hypothesis that the population mean of I·Q's is 100 at 5% level of significance? Given $t_{0.05} = 2.26$. **(07 Marks)**

c. A sample of 900 items is found to have the mean 3.4. Can it be reasonably regarded as a truly random sample from a large population with mean 3.25 and standard deviation 1.61 at 5% level of significance? Given $Z_{0.05} = 1.96$ (Two Tailed Test). **(06 Marks)**

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18MATDIP41

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Additional Mathematics – II

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Find the rank of $\begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$. **(06 Marks)**

b. Solve by using Gauss elimination method. Given $x+y+z=9$, $2x+y-z=0$ and $2x+5y+7z=52$. **(07 Marks)**

c. Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$. **(07 Marks)**

OR

2 a. Find the rank of the matrix $\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$. **(06 Marks)**

b. Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} -19 & 7 \\ -42 & 16 \end{bmatrix}$. **(07 Marks)**

c. Find the values of λ and μ so that the equations $x+y+z=6$, $x+2y+3z=10$ and $x+2y+\lambda z=\mu$ have (i) no solution (ii) a unique solution (iii) an infinite number of solutions. **(07 Marks)**

Module-2

3 a. Using Newton Raphson method, find the real root of the equation $3x = \cos x + 1$, correct to four decimal places. Take $x = 0.6$ as the initial approximation. **(06 Marks)**

b. Given f(40) = 184, f(50) = 204, f(60) = 226, f(70) = 250, f(80) = 276, f(90) = 304. Find f(85) using Newton's backward difference interpolation formula. **(07 Marks)**

c. Evaluate $\int_0^6 \frac{1}{1+x^2}dx$ by using Simpson's $\frac{1}{3}$ rule by considering 6 subintervals. **(07 Marks)**

OR

4 a. Using Regula Falsi method, find a real root of the equation $x\log_{10} x - 1.2 = 0$ which lies in (2, 3). Carryout 3 iterations. **(06 Marks)**

b. Using the following data, find y when x = 1. Given,

x	3	4	5	6	7	8	9
y	4.8	8.4	14.5	23.6	36.2	52.8	73.9

Use Newton's forward interpolation formula. **(07 Marks)**

c. Evaluate $\int_4^{5.2} \log x\, dx$ by using Weddle's rules taking 6 subintervals. **(07 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-3

5 a. Solve $(D^3 + 3D^2 + 3D + 1)y = 0$. (06 Marks)

b. Solve $(D^2 + 7D + 12)y = \cosh x$. (07 Marks)

c. Solve $(D^2 - 4D + 4)y = \cos 2x$. (07 Marks)

OR

6 a. Solve $(4D^4 - 8D^3 - 7D^2 + 11D + 6)y = 0$. (06 Marks)

b. Solve $(D^2 - 6D + 9)y = 6e^{3x}$. (07 Marks)

c. Solve $(D^2 - 5D + 6)y = \sin 3x$. (07 Marks)

Module-4

7 a. Form the partial differential equation by eliminating arbitrary functions from $z = y^2 + 2f\left(\frac{1}{x} + \log y\right)$. (06 Marks)

b. Form the PDE by eliminating arbitrary constants a and b from the relation $(x-a)^2 + (y-b)^2 + z^2 = k^2$. (07 Marks)

c. Solve $\frac{\partial^2 z}{\partial x^2} = a^2 z$, given that when x = 0, z = 0 and $\frac{\partial z}{\partial x} = a \sin y$. (07 Marks)

OR

8 a. Form a partial differential equation by eliminating the arbitrary function from $\phi(x + y + z,\ x^2 + y^2 + z^2) = 0$. (06 Marks)

b. Form a partial differential equation by eliminating arbitrary function from $z = f(x + ct) + g(x - ct)$. (07 Marks)

c. Solve $\frac{\partial^2 z}{\partial x \partial y} = \sin x \sin y$ by direct integration. Given that $\frac{\partial z}{\partial y} = -2\sin y$ when x = 0 and z = 0 when y is an odd multiple of $\frac{\pi}{2}$. (07 Marks)

Module-5

9 a. Given $P(A) = \frac{1}{4}$, $P(B) = \frac{1}{3}$ and $P(A \cup B) = \frac{1}{2}$. Find P(A/B), P(B/A), $P(A \cap \overline{B})$ and $P(A/\overline{B})$. (06 Marks)

b. The probability that three students A, B, C, solve a problem is $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ respectively. If the problem is simultaneously assigned to all of them, what is the probability that the problem is solved? (07 Marks)

c. State and prove Baye's theorem. (07 Marks)

OR

10 a. If A and B are independent events, show that $\overline{A}$ and $\overline{B}$ are also independent. (06 Marks)

b. The probability that a team wins a match is $\frac{3}{5}$. If this team plays 3 matches in a tournament, what is the probability that the team wins (i) atleast one match (ii) all matches. (07 Marks)

c. An office has 4 secretaries handling respectively 20%, 60% and 15% and 5% of the files of all government reports. The probability that they misfile such reports is respectively 0.05, 0.1 and 0.05. Find the probability that a misfiled report can be blamed on first secretary? (07 Marks)

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CBCS SCHEME

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Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Analog Circuits

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Mention and explain the design issues of a classical biasing for BJT using collector-to-base feedback resistor and which uses single power supply. **(10 Marks)**

b. Design classical bias network of amplifier to establish a current $I_E = 1$ mA using a power supply $V_{CC} = +12$ V and transistor has $\beta = 100$. **(10 Marks)**

OR

2 a. Explain the design of biasing technique for discrete MOSFET by fixing V_G and connecting a resistance in source and drain-to-Gate feedback resistor. **(10 Marks)**

b. Determine voltage gain of transistor amplifier for the circuit shown in Fig.Q2(b). Assume $\beta = 100$.

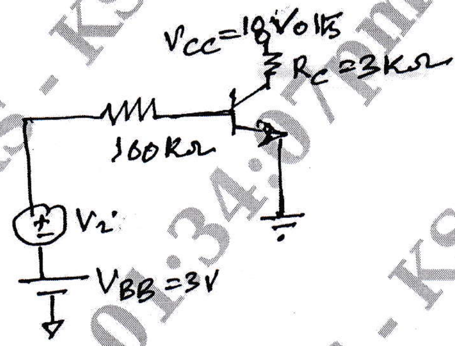

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. Deduce and expression for upper cut off frequency of MOSFET – common source amplifier. **(10 Marks)**

b. Find the mid band gain A_M and the upper 3-dB frequency f_H of a CS amplifier fed with a signal source having an internal resistance $R_{sig} = 100$ KΩ. The amplifier has $R_G = 4.7$ MΩ, $R_D = R_L = 15$ KΩ, $g_m = 1$ mA/V, $r_0 = 150$ KΩ, $C_{gs} = 1$ PF and $C_{gd} = 0.4$ pf. **(10 Marks)**

OR

4 a. With a neat circuit diagram, explain the operation of FET based phase shift oscillator. **(10 Marks)**

b. With a neat circuit diagram, explain the operation of crystal oscillator along with relevant equation for frequency of oscillation. **(10 Marks)**

Module-3

5 a. Discuss the properties of negative feedback. **(10 Marks)**

b. Using ideal structure and equivalent circuit. Deduce an expression for input and output resistance of:

(i) Series shunt feedback amplifiers

(ii) Shunt-shunt configuration **(10 Marks)**

OR

6 a. Derive an expression efficiency of class C power amplifier. **(10 Marks)**

b. Deduce an expression for output resistance by discussing the circuit operation of class AB output stage. **(10 Marks)**

Module-4

7 a. For a practical inverting amplifier the values of R_1 and R_f are 470 Ω and 4.7 KΩ. The various specifications for opamp used are:
Open loop gain = 2×10^5
Input resistance = 2 MΩ
Output resistance = 75 Ω
Single break frequency = 5 Hz
Supply voltages = ±15V
Calculate closed loop voltage gain, i/p and o/p resistance and bandwidth with feedback. **(10 Marks)**

b. Mention and explain the requirements of a good instrumentation amplifier and analyze three opamp instrumentation amplifier. **(10 Marks)**

OR

8 a. Design an opamp Schmitt trigger with following specifications UTP = 2V, LTP = –4V and the output swings between ±10V. If the input is $5 \sin \omega t$, plot the waveforms of input and output. **(10 Marks)**

b. Discussing the circuit operation of (i) DC amplifiers (ii) AC amplifiers, using OPAMPS. **(10 Marks)**

Module-5

9 a. Explain the circuit operation of monoshot using IC555. Derive the expression of pulse width. **(10 Marks)**

b. For the circuit shown in Fig.Q9(b), determine the lower cutoff frequency and then plot the frequency response of fitter.

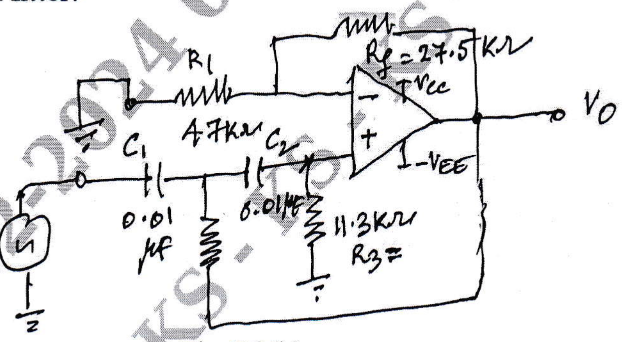

Fig.Q9(b) **(10 Marks)**

OR

10 a. Discuss the circuit operation of Astable multivibrator using IC555. Derive an expression for frequency of oscillations. **(10 Marks)**

b. Discuss the working of successive approximation ADC. **(10 Marks)**

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CBCS SCHEME

USN 18EC43

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Control Systems

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Differentiate between Open loop and Closed loop control systems. **(06 Marks)**

b. For a mechanical system shown in Fig. Q1(b), obtain analogous electrical network by F – V analogy. **(14 Marks)**

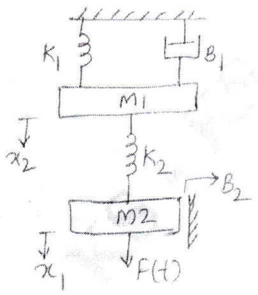

Fig. Q1(b)

OR

2 a. Explain the terms : i) Physical system ii) Physical model iii) Mathematical model iv) Transfer function. **(08 Marks)**

b. For a mechanical system shown in Fig. Q2(b), obtain analogous electrical network by T – V analogy. **(12 Marks)**

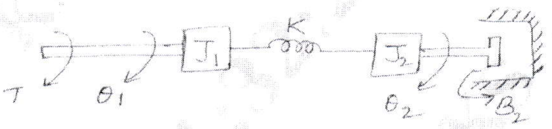

Fig. Q2(b)

Module-2

3 a. Explain with block diagram, Reduction rules. **(08 Marks)**

b. Using the block diagram, reduction techniques, find the Closed – loop transfer function of the system shown in Fig. Q3(b). **(12 Marks)**

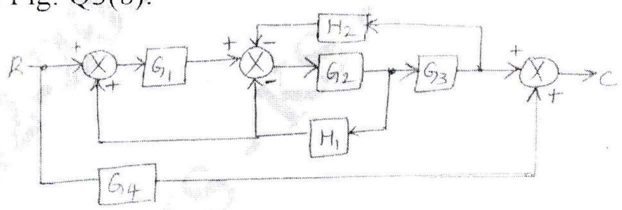

Fig. Q3(b)

OR

4 a. Write Mason's gain formula for signal flow graph and indicate the each term. **(05 Marks)**

b. Draw the signal flow graph for the system shown in Fig. Q4(b) and find $\frac{C(s)}{R(s)}$. **(15 Marks)**

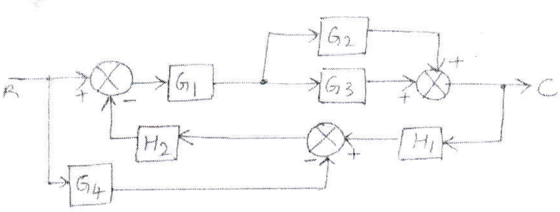

Fig. Q4(b)

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2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-3

5 a. Derive the time response of a critically damped second order system subjected to unit step input. **(10 Marks)**

b. For a unity feedback control system with $G(s) = \dfrac{64}{S(s+9.6)}$, write the output response to a unit step input. Determine i) the response at t = 0.1S.
ii) Maximum value of the response and the time at which it occurs.
iii) Settling time at 2% tolerance. **(10 Marks)**

OR

6 a. Obtain the steady state errors of Type – 0 , Type – 1 and Type – 2 systems for unit step input and unit ramp input. **(12 Marks)**

b. Derive expressions for rise time and peak time of a under damped second order system. **(08 Marks)**

Module-4

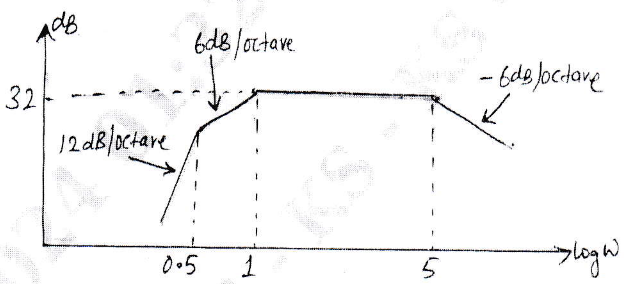
7 a. Examine the stability of a system with characteristic equation $S^5 + S^4 + 2S^3 + 2S^2 + 3S + 5 = 0$. **(06 Marks)**

b. Consider a feedback system with characteristic equation $1 + \dfrac{K}{S(s+1)(s+2)} = 0$. Draw the root locus and show clearly i) Breakaway points ii) The frequency at which root locus crosses imaginary axis and corresponding vale of K. **(14 Marks)**

OR

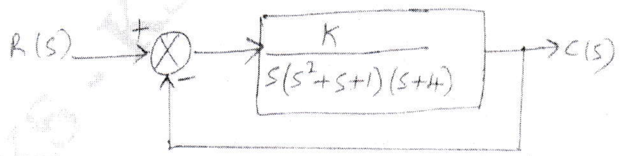
8 a. For the Bode plot shown in Fig. Q8(a), find the transfer function : **(10 Marks)**

Fig. Q8(a)



b. Consider a Closed loop feedback system shown in Fig. Q8(b). Determine the range of K for which the system is stable using Routh criteria. Find the value of K that will cause sustained oscillation in the system. Also find frequency of sustained oscillation. **(10 Marks)**

Fig. Q8(b)



Module-5

9 a. Draw the Polar plot for a system with Open loop transfer function $G(s)\,H(s) = \dfrac{1}{1+Ts}$, where T is constant. **(06 Marks)**

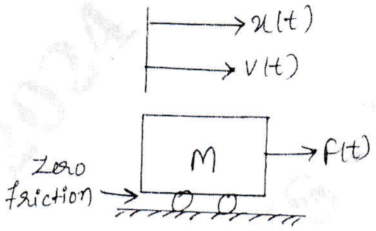
b. A unity feedback system has $G(s) = \dfrac{10}{S(s+1)(s+2)}$. Draw the Nyquist plot and comment on Closed – loop stability. **(14 Marks)**

OR

10 a. Define State and State Variable. Explain the State model of linear systems. **(08 Marks)**

b. For a mechanical system shown in Fig.Q10(b), obtain the state model by choosing displacement x(t) and velocity v(t) as state variable. **(12 Marks)**

Fig. Q10(b)



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CBCS SCHEME

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18EC44

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Engineering Statistics & Linear Algebra

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Define a random variable and briefly discuss the following terms associated with random variable.
(i) Sample space.
(ii) Distribute function.
(iii) Probability mass function.
(iv) Probability density function. **(06 Marks)**

b. The pdf for random variable Y is given by,
$$f_y(y) = \begin{cases} 1.5(1-y^2), & 0 < y < 1 \\ 0, & \text{otherwise} \end{cases}.$$
(i) What are the mean?
(ii) What are the mean of square?
(iii) What are the variance of the random variable Y? **(06 Marks)**

c. Define an uniform random variable. Obtain the characteristics function of an uniform random variable and using the characteristic function derive its mean and variance. **(08 Marks)**

OR

2 a. The probability density function of a random variable 'x' is defined as,
$$f_x(x) = \begin{cases} K.e^{-4x} & x > 0 \\ 0 & x \le 0 \end{cases}.$$
Find
(i) Constant K.
(ii) $P(1 < x < 2)$
(iii) $P(x \ge 3)$
(iv) $P(x < 1)$ **(08 Marks)**

b. Given the data in the following table :

k	1	2	3	4	5
Z_k	2.1	3.2	4.8	5.4	6.9
$P(Z_k)$	0.19	0.22	0.20	0.18	0.21

(i) Plot the pdf and the cdf of the discrete random variable z.
(ii) Write expressions for $f_Z(2)$ and $F_Z(2)$ using unit delta function and unit step function respectively. **(06 Marks)**

c. Define Poisson distribution. Obtain the characteristic function of a Poisson random variable and using the characteristic function derive its mean and variance. **(06 Marks)**

Module-2

3 a. The joint pdf $f_{xy}(x,y) = C$, a constant, when $(0 < x < 2)$ and $(0 < y < 3)$ and is 0 otherwise.
   (i) What is the value of constant C?
   (ii) What are the pdfs for X and Y?
   (iii) What is $F_{XY}(x, y)$ when $(0 < x < 2)$ and $(0 < y < 3)$?
   (iv) What are $F_{XY}(x, \infty)$ and $F_{XY}(\infty, y)$?
   (v) Are x and y independent? **(10 Marks)**

b. The mean and variance of random variable x are -2 and 3 ; the mean and variance of y are 3 and 5. The covariance Cov(xy) = -0.8. What are the correlation coefficient ρ_{XY} and the correlation E[XY]. **(06 Marks)**

c. Define correlation coefficient of random variable X and Y. Show that it is bounded by limit ± 1. **(04 Marks)**

OR

4 a. The zero mean bivariate random variables X_1 and X_2 have the following variances : $Var[X_1] = 2$ and $Var[X_2] = 4$. Their correlation coefficient is 0.8. Random variables Y_1 and Y_2 are obtained from,
$Y_1 = 3X_1 + 4X_2$, $Y_2 = -X_1 + 2X_2$
Find values for $Var[Y_1]$, $Var[Y_2]$ and $COV[Y_1\, Y_2]$ **(08 Marks)**

b. X is a random variable uniformly distributed between 0 and 3. Z is a random variable, independent of X, uniformly distributed between +1 and -1. U = X + Z, what is the pdf for U? **(08 Marks)**

c. Explain briefly the following random variables:
   (i) Chi-square Random variable.
   (ii) Raleigh Random variable. **(04 Marks)**

Module-3

5 a. With the help of an example, define Random process and discuss the terms Strict-Sense Stationary (SSS) and Wide Sense Stationary (WSS) associated with a random process. **(06 Marks)**

b. Two jointly wide sense stationary random process have the same functions of the form $x(t) = A\cos(w_0 t + \theta)$ and $y(t) = B\cos(w_0 t + \theta + \phi)$. Here A, B and ϕ are constants, θ is the random variable uniformly distributed between 0 to 2π. Find the cross correlation function $R_{XY}(t)$. **(06 Marks)**

c. Define the Autocorrelation function (ACF) of the random process X(t) and prove the following statements :
   (i) ACF is an even function.
   (ii) If X(t) is periodic with period T, then in the WSS case, ACF is also periodic with period T. **(08 Marks)**

OR

6 a. A random process is described by,
$X(t) = A\sin(w_c t + \theta)$
Where A and w_c are constants and where θ is a random variable uniformly distributed between $\pm\pi$. Is x(t) wide sense stationary. If not, then why not? If so, then what are the mean and the autocorrelation function for the random process? **(06 Marks)**

b. x(t) and y(t) are zero-mean, jointly wide sense stationary random processes. The random process z(t) is,
$z(t) = 3x(t) + y(t)$.
Find the correlation functions $R_Z(\tau)$, $R_{ZX}(\tau)$, $R_{XZ}(\tau)$ and $R_{YZ}(\tau)$. **(08 Marks)**

c. Assume that the data in the following table are obtained from a windowed sample function obtained from an ergodic random process. Estimate the autocorrelation function for $\tau = 0$, 3 and 6 ms, where $\Delta t = 3$ ms.

x(t)	1.0	2.2	1.5	−3.0	−0.5	1.7	−3.5	−1.5	1.6	−1.3
k	0	1	2	3	4	5	6	7	8	9

(06 Marks)

Module-4

7 a. Determine if the following set of vectors will be basis for R^3.
$u_1 = (1,-1,1)$, $u_2 = (0,1,2)$, $u_3 = (3,0,-1)$ (05 Marks)

b. Determine if the following sets of vectors are linearly independent or linearly dependent :
$$v_1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix},\ v_2 = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} \text{ and } v_3 = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}.$$
(05 Marks)

c. Apply Gram-Schmitt process to the vectors $v_1 = (2,2,1)$, $v_2 = (1,3,1)$ and $v_3 = (1,2,2)$ to obtain an orthonormal basis for $v_3(R)$ with standard inner product. (10 Marks)

OR

8 a. Determine Rank of the matrix A, $A = \begin{bmatrix} 1 & 3 & 9 \\ 4 & 1 & 3 \\ 9 & 4 & 12 \end{bmatrix}$. (04 Marks)

b. Solve $Ax = b$ by least squares and find the projections of b on to the column space of A.
$$A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 1 \end{bmatrix} \text{ and } b = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$$
(06 Marks)

c. Explain the following :
(i) Rank Nullity theorem.
(ii) Gram-Schmidt orthogonalization procedure. (10 Marks)

Module-5

9 a. Briefly explain the following :
(i) Cofactors of the determinant.
(ii) Symmetric matrix and its properties. (04 Marks)

b. If $A = \begin{bmatrix} 4 & 2 & -2 \\ -5 & 3 & 2 \\ -2 & 4 & 1 \end{bmatrix}$. Find eigen values and corresponding eigen vectors for matrix A. (08 Marks)

c. Factor the matrix A into $P^{-1}AP$ using diagonalization and hence find D^4.
$$A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$$
(08 Marks)

OR

10 a. If $A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ show that matrix A is positive definite matrix. **(04 Marks)**

b. Diagonalize the following matrix if possible :

$$A = \begin{bmatrix} 1 & 3 & 3 \\ -3 & -5 & -3 \\ 3 & 3 & 1 \end{bmatrix}$$

(06 Marks)

c. Factorize the matrix A into $A = U\sum V^T$ using SVD.

$$A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \\ -1 & 1 \end{bmatrix}.$$

(10 Marks)

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CBCS SCHEME

USN | | | | | | | | | | |

18EC45

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Signals and Systems

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define Signal. List the various classifications of signals with suitable expressions/diagrams. **(06 Marks)**

b. Sketch the even and odd components of the following signals

i) $x(n) = u(n) - u(-n-1)$

ii) $x(t) = r(t) - 2r(t-1) + r(t-2)$ where $r(t) = t \cdot u(t)$. **(08 Marks)**

c. Determine whether the following signals are energy or power signals. Also determine their average power/total energy

i) $x(n) = \alpha^n u(n)$ ii) $x(t) = 5ws(\pi t)$. **(06 Marks)**

OR

2 a. List all the continuous time elementary signals with necessary expressions and suitable diagrams. **(06 Marks)**

b. Determine whether the following signals are periodic or not. If periodic, determine their fundamental period

i) $x(n) = \text{Cos}\left(\frac{\pi}{2}n\right) \cdot \text{Cos}\left(\frac{\pi}{4}n\right)$

ii) $x(t) = 2\text{Cos}\, t + 3\text{Cos}(\pi t)$ **(06 Marks)**

c. For signals x(t) and y(t) as given in Fig Q2(c), sketch the following

i) $x(2t) \cdot y\left(\frac{1}{2}t+1\right)$ ii) $x(t+1)(2-1)$.

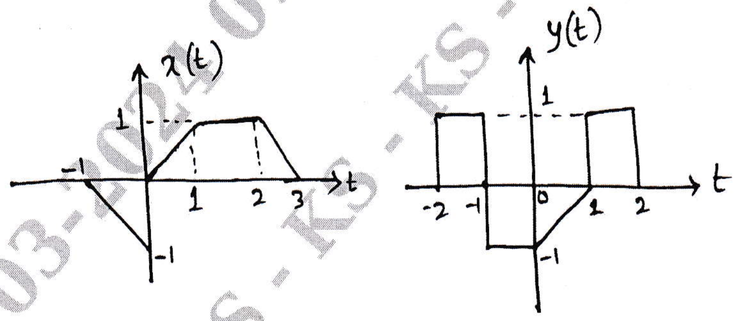

Fig Q2(c) **(08 Marks)**

Module-2

3 a. List all the basic system properties with respect to continuous time systems, with definition, necessary expressions and example. **(08 Marks)**

b. Convolute $x(n) = \{1, 2, -\underset{\uparrow}{1}, 1\}$ and $h(n) = \{1, \underset{\uparrow}{0}, 1\}$ using graphical method. **(04 Marks)**

c. For an LTI system characterized by impulse response $h(n) = \beta^n u(n)$, $0 < \beta < 1$, find the output of the system for input x(n) given by $x(n) = \alpha^n [u(n) - u(n-10)]$. **(08 Marks)**

OR

4 a. Determine whether the systems given by the following input output are causal, linear, time – invariant, stable. Justify
i) $y(n) = (n + 1)\, x(n)$ ii) $y(t) = x(t) + 10$ **(08 Marks)**

b. Derive the equation for convolution sum. **(04 Marks)**

c. Convolute the signals $x_1(t) = \{u(t + 2) - u(t - 1)\}$ and $x_2(t) = u(2 - t)$. **(08 Marks)**

Module-3

5 a. State and prove the associative property of convolution integral. **(04 Marks)**

b. Given the impulse response, determine whether each of the following systems are stable, memoryless, causal. Justify your answer with suitable explanation. **(08 Marks)**
i) $h(n) = (0.8)^n u(n + 2)$
ii) $h(t) = e^{-6t} u(3 - t)$

c. Obtain the Fourier series representation for the signal $x(t) = \sin(2\pi t) + \cos(3\pi t)$. Sketch the magnitude and phase spectra. **(08 Marks)**

OR

6 a. Evaluate the step response for the systems with impulse response as given below.
i) $h(t) = e^{-|t|}$
ii) $h(n) = \left(\frac{1}{2}\right)^n u(n)$ **(10 Marks)**

b. Find the Fourier series of the signal shown in Fig Q6(b)

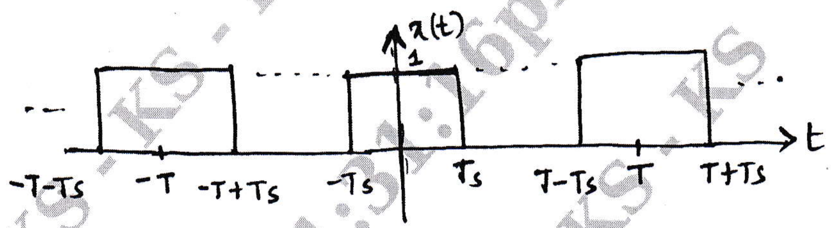

Fig Q6(b) **(10 Marks)**

Module-4

7 a. State and prove the time shift property of Discrete Time Fourier Transform. **(04 Marks)**

b. Evaluate the Fourier transform of the following signals. Also draw spectrum. **(08 Marks)**
i) $x(t) = e^{-at} \cdot u(t), a > 0$
ii) $x(t) = \delta(t)$

c. Evaluate the DTFT for the signal x(n) shown in Fig Q7(c)

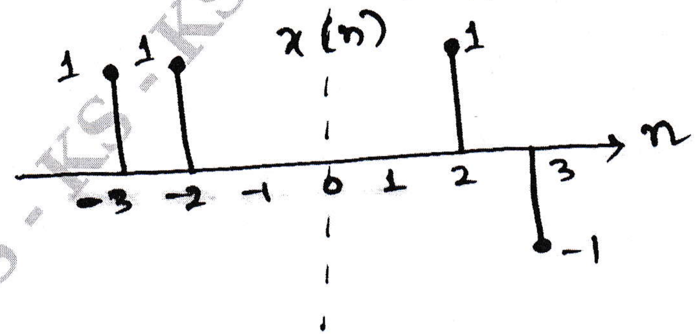

Fig Q7(c) **(08 Marks)**

OR

8 a. Using appropriate properties, find the DTFT of the signal $x(n) = \text{Sin}\left(\frac{\pi}{4}n\right)\left(\frac{1}{4}\right)^n u(n-1)$. **(08 Marks)**

b. Determine the inverse Fourier transform of the following signals

i) $x(jw) = \dfrac{5jw + 12}{(jw)^2 + 5jw + 6}$

ii) $x(jw) = \dfrac{jw}{(2 + jw)^2}$ **(08 Marks)**

c. State and prove time differentiation property of Fourier transform. **(04 Marks)**

Module-5

9 a. List all the properties of Region of convergence (ROC). **(04 Marks)**

b. Determine the Z-transform, the ROC and the locations of poles and zeros of x(z) for the following signals

i) $x(n) = -\left(\frac{3}{4}\right)^n u(-n-1) + \left(\frac{-1}{3}\right)^n u(n)$

ii) $x(n) = n \cdot \text{Sin}\left(\frac{\pi}{2}n\right)u(-n)$ **(08 Marks)**

c. Find the inverse z-transform of $x(z) = \dfrac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)(1 - 2z^{-1})(1 - z^{-1})}$ with following ROCs

i) $1 < |z| < 2$

ii) $\frac{1}{2} < |z| < 1$. **(08 Marks)**

OR

10 a. Determine the z-transform and ROC for the signal $x(n) = \left(\frac{1}{2}\right)^n \{u(n) - u(n-10)\}$. **(04 Marks)**

b. Using power series expansion method, determine inverse Z-transform of

i) $x(z) = \text{Cos}(z^{-2})$ ROC $|z| > 0$

ii) $x(z) = \dfrac{1}{1 - \left(\frac{1}{4}\right)z^{-2}}$ ROC $|z| > \frac{1}{4}$. **(08 Marks)**

c. Find the transfer function and the impulse response of a causal LTI system if the input to the system is $x(n) = \left(-\frac{1}{3}\right)^n u(n)$ and the output is $y(n) = 3(-1)^n u(n) + \left(\frac{1}{3}\right)^n u(n)$. **(08 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | | **18EC46**

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Microcontroller

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. With a block diagram explain the architecture of 8051 microcontroller. **(10 Marks)**

b. Explain when overflow, auxiliary and parity flag bit is set in 8051 Program Status Word (PSW) register. What will be the value of PSW after the execution of following instructions:

```
MOV A, #40H
MOV B, #3FH
ADD A, B
```
(10 Marks)

OR

2 a. Interface 8051 microcontroller with 4KB of ROM and 64KB of RAM. **(10 Marks)**

b. With diagram explain the structure of RAM. **(05 Marks)**

c. Explain Port0 pin configuration with a diagram. **(05 Marks)**

Module-2

3 a. What is an addressing mode? Explain the different types of addressing modes with an example each. **(10 Marks)**

b. Explain the operation of following instructions with one example each:
i) PUSH ii) XRL A, B iii) DIV A B **(06 Marks)**

c. Write assembly level program to add the contents of A and B Register and store result in 50H location. **(04 Marks)**

OR

4 a. Explain conditional and unconditional Jump instruction with an example. **(08 Marks)**

b. Check if the instructions given are valid or not. Write the reason and correct the invalid instruction.
(i) MOV R_0, DPT R (ii) MOV A, @Ry
(iii) MOV #20H, 30H (iv) MOV R_0, @R_1 **(08 Marks)**

c. Write assembly level program to multiply the contents of A and B register and store result in 30H location. **(04 Marks)**

Module-3

5 a. What is a subroutine? Explain the advantages of a subroutine. What are the sequence of operations that takes place when call and return instructions are executed? **(08 Marks)**

b. With a diagram explain stack structure and its operation. **(07 Marks)**

c. Write assembly level program to check the position of switch connected to $P_{0.0}$. If the switch is ON turn on LED connected to $P_{1.0}$. **(05 Marks)**

OR

6 a. Explain PUSH and POP instructions with an example. **(08 Marks)**
b. Write assembly level program to add two numbers stored in locations 20H and 21H using stack instructions. **(04 Marks)**
c. Explain CALL and RET instructions. **(08 Marks)**

Module-4

7 a. With the bit pattern explain TMOD register. **(08 Marks)**
b. Explain autoreload mode of timer1. How to make timer1 work as a counter? **(08 Marks)**
c. Write assembly level program using autoreload mode of timer0 to generate a frequency of 10 kHz on $P_{1.2}$. **(04 Marks)**

OR

8 a. With a bit pattern explain TCON register. **(08 Marks)**
b. Explain bit pattern of SCON register. **(08 Marks)**
c. Explain the importance of MAX232IC in serial communication. **(04 Marks)**

Module-5

9 a. With a bit pattern explain IE register. Explain how interrupt priority can be changed using IP register. **(10 Marks)**
b. With a diagram explain 8051 interface with ADC. Write a assembly level code to interface ADC 0804 to 8051 microcontroller. **(10 Marks)**

OR

10 a. Explain stepper motor interface with a microcontroller. Write assembly level code to run stepper motor continuously in clockwise direction. **(10 Marks)**
b. Explain DAC interface with 8051 microcontroller. Write a program to generate any waveform. **(10 Marks)**

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